appear to fit all the cases equally well. To the reviewer, at least, a rather different "mental mechanism" would seem to fit the case histories better. In particular, the association between sex behavior and such other forms of misconduct as stealing and truancy is perhaps not so purely accidental and extraneous as the author assumes; for all of these forms of bad conduct typify for the child that life of "badness" which, perhaps because of its rebellion against authority and restraint, makes a certain appeal even to the "good" child. That is to say that the child does not resort to stealing as an outlet for dammed-up energy primarily directed towards sex behavior, but that, being incited to "badness" in several directions, and responding in some measure to the incitation, he follows the line that he is able to understand and follow with some success, leaving aside what he is not ripe for, though perhaps being mystified and obsessed by this latter.

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Telephone Apparatus. By George D. Shepardson, Professor of Electrical Engineering, University of Minnesota. D. Appleton & Co. 1917. 337 pages, 115 illustrations.

Considering the marvelous rapidity of growth of telephony and the extent to which the telephone permeates the daily life of the modern business man, especially in America, where there is an average of one telephone to each ten persons, it is surprising how little is generally known concerning the history, construction or mode of operation of that wonderful device. This book presents an introduction to the development and theory of telephony for the educated classes of the public in general, and particularly for those engaged in telephonic operation or manufacture.

The book contains sixteen chapters, relating respectively to the following subjects: Introduction, Sound, Speech sounds, Telephone receivers, Telephone-receiver investigations, Telephone transmitters, Telephone-transmitter investigations, Signaling devices, Design of non-polarized signaling apparatus, Permanent magnets and polarized apparatus, Design of polarized apparatus, Electromotive forces and currents, Principles of induction coils, Uses of induction coils in telephony, Condensers in telephony, Protective devices. The treatment is directly descriptive, abundantly illustrated by pictures and diagrams of the apparatus. The mathematical analysis is nearly all collected into the appendices at the end of the book, so that a non-mathematical reader can peruse all the chapters with very few interruptions.

The book deals mainly with telephonic apparatus, and the principles underlying its operation. Circuit arrangements are given relatively minor consideration, and radio-telephony is not included. A good set of indexes at the end of the volume greatly assists the reader.

A noteworthy feature of the book is the large number of collateral references indicated in footnotes throughout the text. The collection and collation of so much historical and technical material represents a large amount of labor. The insertion of this subordinate material makes the work of great value as a reference book to telephonists and students of telephony. Probably no other text-book on telephony in the English language contains such a wealth of electro-technical reference material.

A. E. K.

SPECIAL ARTICLES

ANESTHESIA AND RESPIRATION[1]

There is much uncertainty as to the effect of anesthetics upon respiration. Some writers hold that anesthetics decrease respiration while others take the opposite view.[2] To clear up this confusion appears to be a necessary step toward a satisfactory theory of anesthesia.

[1] Preliminary communication.

[2] *Cf.* Höber, R., "Physik. Chem. der Zelle und der Gewebe," Ch. 8 und 9, 1914. Czapek, F., *Biochem. der Pflanzen,* Vol. I., S. 195 ff., 1913. Ewart, A. J., *Annals of Bot.,* 12: 415, 1898. Tashiro, S. and Adams, H. S., *Amer. Jour. of Physiol.,* 33 xxxviii, 1914. Appleman, C. O., *Amer. Jour. of Bot.,* Vol. 3, No. 5, May, 1916.

The writer has recently been able to develop a method[3] for the measurement of minute amounts of carbon dioxide. The application of this method to the present problem has yielded interesting results.

The experiments were made by measuring the change in the hydrogen-ion concentration of sea-water produced by the respiration of the marine alga, *Laminaria*. This was conveniently done by the addition of a suitable indicator (phenosulphonephthalein) to the sea-water and comparing the color of the solution with the colors of a series of buffer solutions of known hydrogen-ion concentration (containing the same concentration of indicator).

When the concentration of the anesthetic was so great as to cause considerable dilution of the sea water, concentrated sea water was added until the mixture had the same electrical conductivity as sea-water. When an anesthetic (as formaldehyde) showed an unusually high acidity, the free acid was first neutralized with sodium carbonate. This is allowable for the purposes of the present investigation, as its only effect would be to make the amount of CO_2 produced appear somewhat less than was actually the case. By selection of sea-water from different carboys, sea-water could be obtained for controls that had the same PH value as that of the sea-water containing the anesthetic.

The fronds were cut up into pieces about two inches long, the cutting being reduced to a minimum, since it is known that an increase of respiration may follow injury.[4] Preliminary experiments, in which uncut smaller fronds were used for comparison with the cut fronds, showed that the change in the respiration due to the cutting was negligible (especially since the cut pieces were usually left about half an hour in sea-water before being used).

Each piece of tissue was inserted into a Pyrex glass tube, closed by fusion at one end, a piece of paraffined rubber tubing being attached to the open end. Sea-water was then added, the solutions being the same temperature as the bath. The temperature of the bath was always kept at 16° C. Black-enamelled collapsible tin tubes served to exclude light from the tubes. After the sea-water bathing the tissue had been changed several times, a given amount of sea-water was added to the tube and a small bubble of air was included in order to serve as a stirrer (it was found to be preferable to paraffined glass beads). After the tube had been kept in the dark at 16° C. for a definite period it was removed from the bath and stirred by inverting the tube a few times. The clamp was then opened and the solution rapidly poured into an empty tube, to which the same number of drops of indicator had been added as was added to the buffer solutions. The solution was then mixed with the indicator in the manner just described and the color was then compared with buffer solutions of a known PH value (containing the same concentration of indicator). The decrease in PH as observed with a constant source of light ("Daylight" lamp) served to measure the amount of CO_2 produced by respiration.

In order to be sure that no acid except CO_2 was being given off by the plant a stream of hydrogen was allowed to bubble through the solution which had been made acid by respiration in order to see whether it came back to the same PH value as at the start.[5] This was the case in every instance.

Each piece of material was used for a number of periods (always of the same length) in sea-water (which was changed at the end of each period) until the rate of respiration had become practically constant. Then several of the pieces were used as controls while others were placed in sea-water containing the anesthetic (the solutions were always renewed at the end of each period).

Experiments were carried on with sea-water containing the following substances: .1 per cent. chloral hydrate, .1 per cent. novocain, 1

[3] Haas, A. R., SCIENCE, N. S., 44: 105, 1916.

[4] *Cf.* Richards, H. M., *Annals of Bot.*, 10: 551, 1896; *ibid.*, 11: 29, 1897.

[5] In very strong concentrations (alcohol 24 per cent. or acetone 17 per cent.) a little pigment may be extracted from the plant. In this case it may be necessary to reject the figures for the first period (or of the first two periods).

per cent. ether, 0.1 per cent. caffeine, ethyl bromide (approximately saturated), 3.2 per cent. formaldehyde, .8 per cent. formaldehyde, .3 per cent. chloroform, .05 per cent. chloroform, 0.1 per cent. acetone, 0.51 per cent. acetone, 17.4 per cent. acetone, 24.2 per cent. ethyl alchohol, 16.1 per cent. ethyl alcohol, 10 per cent. ethyl alcohol, 5 per cent. ethyl alcohol, 2 per cent. ethyl alcohol and 1 per cent. ethyl alcohol.

It was found that whenever the concentration of anesthetic is sufficiently strong to produce any measurable result, the initial effect is always an increase of respiration which may either remain approximately constant over a large number of periods and then gradually decline or the increased rate of respiration may fall very rapidly below the normal when the concentrations of anesthetic are too great.

It is very noteworthy that in no case was the respiration of *Laminaria* observed to fall below the normal when exposed to sea-water containing anesthetic except after prolonged exposure to high concentrations which produced death.

SUMMARY

When *Laminaria* is exposed to the action of anesthetics (in sufficient concentration to produce any result) there is an increase in respiration. This may be followed by a decrease if the reagent is sufficiently toxic. No decrease is observed with low concentrations which are not toxic.

These facts contradict the theory of Verworn that anesthesia is a kind of asphyxia, for his view is based upon the assumption that anesthetics decrease respiration.

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AN OUTLINE OF THE LIFE HISTORY OF THE CLOTHES MOTH, TINEOLA BISELLIELLA

SOME four years ago the writer was asked by Mr. Walter S. Kupper and Mr. J. R. Howlett, of New York City, to undertake an investigation of clothes moths for the purpose of gathering information which would help solve the problem of moth-proofing ordinary woolen fabrics. At that time and at present, the only original information available consisted of disconnected observations, mainly concerned with the case-forming clothes moth, *Tinea*. In connection with the study which followed, hundreds of pounds of fur and old woolen rags were purchased, the moth larvæ painstakingly picked out, and the rags then sold back or thrown away. One lot of eighteen hundred pounds of old rags was purchased at one time. From these several thousand larvæ of *Tineola* was picked out by boys employed for that purpose, and placed on test cloths which had been treated with various chemicals in the hope of finding one which would prevent moth ravages. Two trunksful of fur garments were obtained from the Salvation Army stores. Two hundred pounds of blown fur were purchased from a firm which prepares rabbit fur for the hatter's trade.

The yellow clothes moth, *Tineola biselliella*, was the only moth found in all this material during a period of four years. This seems strange, especially in view of the fact that the rag material had been shipped to New York from all parts of the country, the large bale of cloth above mentioned having come from the south and consisting of dirty cast-off clothing from that region. About three specimens of the spotted clothes moth, *Tinea*, were caught flying about the house in the Bronx, New York City, in which the study was at first carried on, but the circumstances indicated that they were adventitious, and in no way connected with the supply of *Tineola* fur of which only a few cardboard boxes were present at that time. The conclusion would seem inevitable that in the region of New York City, at least, *Tinea* is of comparatively rare occurrence and that the extensive damage which is done in connection with the fur and woolen trades is due almost entirely to the other species. Both the black and the Buffalo carpet beetles were found invariably in each supply of moth material, but in comparatively small numbers. A much larger unidentified beetle occurred in great numbers in the supply of blown hat fur and rabbit skins which had their source in Australia.

Life History.—Mature moths were found